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(71)Applicant : FUJITSU LTD

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(72)Inventor : TOKUYO SHINO
OZAKI MITSUO

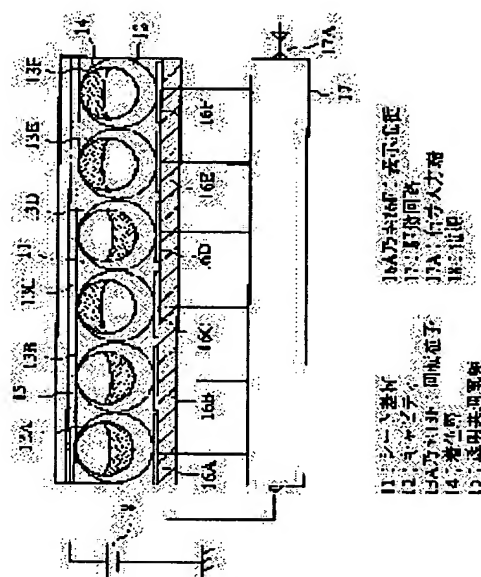
(54) MANUFACTURING METHOD OF SHEET TYPE DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a manufacturing method of a sheet type display device which enables to reduce the adhesiveness between rotating particles and a sheet substrate by a simple means and to ensure the production of a cavity filled with a transparent liquid regardless of the material of the rotating particles.

SOLUTION: In the manufacturing method of manufacturing a sheet type display device by producing a sheet substrate 11 by dispersing rotating particles 13A, etc., that have areas of different optical characteristics on their surface over an optically transparent layer to make a sheet and making it swelled with a transparent liquid to form a cavity 12 filled with the transparent liquid around the rotating particles 13A, etc., a material whose critical surface tension is the same as or less than that of the sheet substrate 11 is used for the rotating particles 13A etc.

シート状表示装置の製造方法の断り図



11: シート状表示装置
12: 透明層
13A: 回転粒子
13B: 回転粒子
13C: 回転粒子
13D: 回転粒子
13E: 回転粒子
13F: 回転粒子
13G: 回転粒子
13H: 回転粒子
13I: 回転粒子
13J: 回転粒子
13K: 回転粒子
13L: 回転粒子
13M: 回転粒子
13N: 回転粒子
13O: 回転粒子
13P: 回転粒子
13Q: 回転粒子
13R: 回転粒子
13S: 回転粒子
13T: 回転粒子
13U: 回転粒子
13V: 回転粒子
13W: 回転粒子
13X: 回転粒子
13Y: 回転粒子
13Z: 回転粒子
14: 透明液体
15: 透明液体
16: 透明層
17: 透明層
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【特許請求の範囲】

【請求項1】表面に光学的特性を異にする領域をもつ回転粒子を光学的に透明な層に分散してシートを作製する工程、及び、前記シートを透光性液体に依って膨潤させ前記回転粒子の周囲に前記透光性液体が充填されたキャビティを生成させてシート基材を作製する工程を含むシート状表示装置の製造方法に於いて、

前記回転粒子は臨界面張力が前記シート基材の臨界面張力と同等か若しくはそれ以下である材料からなることを特徴とするシート状表示装置の製造方法。

【請求項2】回転粒子の表面に臨界面張力がシート基材の臨界面張力と同等か若しくはそれ以下である材料層を形成することを特徴とする請求項1記載のシート状表示装置の製造方法。

【請求項3】材料層が透光性液体に溶解する材料からなることを特徴とする請求項2記載のシート状表示装置の製造方法。

【請求項4】材料層を不活性溶液中に分散したフッ素系ポリマで形成することを特徴とする請求項2記載のシート状表示装置の製造方法。

【請求項5】材料層を形成してから剥離を抑止する為の熱処理を加えることを特徴とする請求項2記載のシート状表示装置の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、光学的に透明な基材に透光性液体を充填した複数の空隙を形成し且つ該空隙中に表示用回転粒子を内在させた構造のシート状表示装置を製造する方法の改善に関する。

【0002】

【従来の技術】一般に、電子ペーパー、ペーパーライクディスプレイ、デジタルペーパーなどと呼ばれ、電界の印加に依って光学的吸收或いは光学の反射を変化させ、像表示を行うシート状表示装置（媒体）が知られている。

【0003】例えば特許第2551783号公報（特願昭62-244679号）には、電界に依り光学的吸收や光学の反射を変化する素子として、電気泳動粒子を分散させた溶媒を着色し、この溶媒を内包したマイクロ・カプセルが開示され、また、特開平8-234686号公報（特願平7-343133号）には、色と電気的特性を異にする半球を合わせて結合した回転体を内包したマイクロ・カプセルが開示され、更に、電界で色に変化する二色性色素とスメクチック液晶を含む液晶／高分子複合膜などが知られている。

【0004】前記した表示装置は、メモリ性を有し、電源が遮断されても像情報を保持することが可能であり、また、反射型表示装置である為、反復使用可能な紙の代替物として期待され、更にまた、作成する場合、電極が形成されたPET（polyethyleneterephthalate）フィルム上に塗布することで得ら

れるから、薄く、且つ、軽く、可撓性のシート状物として実現される。

【0005】特に、米国特許第4,126,854号明細書及び同第4,143,103号明細書に開示された表示媒体は、半球づつ異なる色及び帯電特性に分けた回転粒子を用い、他の表示媒体に比較し、優れたコントラスト特性を示すことが知られている。

【0006】図4は米国特許として開示された表示媒体を表す要部切断側面図であり、そして、図5は回転粒子の動きを説明する為の要部切断側面図であり、図に於いて、1は光学的に透明な層からなる基材、2は基材に形成され且つ透光性液体が充填された空隙、3は異なる色及び異なる帯電特性をもつ二つの領域に分けられた回転粒子をそれぞれ示している。

【0007】表示媒体は前記構成を採っている為、電界を印加することで回転粒子の電気泳動と回転運動とが起こって像を表示することができる。尚、回転粒子として、2色のみならず、3色或いは4色に塗り分けるなど多色化したものも提案されている。

【0008】前記回転粒子を製造する方法及び材料として、

（1） 米国特許第5,262,908号明細書には、色が異なる2種類の溶融したワックス粒子を結合させ、表面張力に依って球形化してから固化する方法が開示され、その材料としては、カルナバワックス、カーボンブラック、酸化チタンが挙げられている。

【0009】（2） 特開平11-85067号公報（特願平9-246738号）及び特開平11-85068号（特願平9-246739号）には、光透過性の粒子に於ける表面に金属、カーボンブラック、硫化アンチモンなどを蒸着、或いは、塗布する方法が開示され、その材料としては、ガラスや樹脂が挙げられている。

【0010】（3） 特開平11-85069号公報（特願平9-248527号）及び特開平11-161206号公報（特願平9-330135号）には、感光剤からなる粒子を用い、露光、現像、定着処理を行って発色させる方法が開示され、その材料としては、酸化亜鉛（発色剤はトナー）、親水性高分子（発色剤はハロゲン化銀）が挙げられている。等が知られている。

【0011】この他、回転粒子を構成する材料、例えば、樹脂、ワックス、着色剤などを種々と変えたり、或いは、回転粒子の回転を低エネルギーで行い得るようにして、高解像度で高速応答性が良好な表示をする為に多くの研究開発がなされている。

【0012】回転粒子3の主成分としては、ポリスチレン、ポリアクリル、ポリエチレンなどの樹脂、或いは、ガラスなどを用いるが、製造性の上からは、形状の制御、色分け、帯電制御性などが容易である物質が望ましく、また、回転粒子3の回転や停止などの運動制御の上から、帯電制御性、形状及び大きさの制御性が容易であ

ることに加えて比重も重要であり、更に化学的に安定であって、特に、ある種の透光性液体に不溶であるか、或いは、無視し得る程度であるなど、相互作用が小さい物質であることが必要である。

【0013】因みに、前記性質をもつ回転粒子は、本発明で使用する透光性液体に対しても有用であり、このような物質としては、分子量が5000以下、比重が0.70～1.20であるワックス状物質が適当である。

【0014】前記のようなワックス状物質としては、ステアリン酸、パルミチン酸、ミリスチン酸、ラウリン酸などの高級脂肪酸類、ステアリン酸アルミニウム、ステアリン酸カリウム、パルミチン酸亜鉛などの高級脂肪酸金属塩類、水添ヒマシ油、ココア脂、メチルヒドロキシステアレート、グリセロールモノヒドロキシステアレート等の高級脂肪酸の誘電体類、木ロウ、密ロウ、カルナバワックス、マイクロクリスタリンワックス、パラフィンワックスなどのワックス類、ポリエチレン、ポリプロピレン、エチレン-酢酸ビニル共重合体、エチレン-ビニルアルキルエーテルなどの低分子量のオレフィン重合体及び共重合体などである。

【0015】前記した回転粒子を例えばシリコーンゴムなどのエラストマーに分散して空隙（キャビティ）を作することに依り、シート状表示媒体が得られる。

【0016】回転粒子は、架橋反応前のシリコーンゴム（液状）と十分に混合され、且つ、分散され、この分散系を板状、或いは、膜状に展延し、その後、シリコーンゴムは架橋反応させるのであるが、このようにして作成された回転粒子分散シリコーンゴムに於いては、回転粒子の周囲にキャビティは存在しない。

【0017】前記のようにして作成された回転粒子分散シリコーンゴムの板は、透光性液体の中に浸漬されて適切な時間放置される。

【0018】すると、シリコーンゴム分子中に透光性液体の分子が侵入する為、シリコーンゴムは膨潤するのであるが、回転粒子は透光性液体に不溶であるか、或いは、回転粒子に対する透光性液体の浸透が極めて遅い為、回転粒子の周囲にキャビティが生成され、しかも、この空隙は透光性液体で満たされる。

【0019】ところで、回転粒子の材料としては、高品質の像表示を可能にする為、種々な種類のものが選択使用されているが、シート基材に導入した場合、回転粒子の材料の如何に依っては、透光性液体が充填されたキャビティを生成させることができない旨の問題があった。

【0020】

【発明が解決しようとする課題】本発明では、回転粒子とシート基材間の接着性を簡単な手段で低減させ、回転粒子材料の如何を問わず、透光性液体が充填されたキャビティを確実に生成させることができるようにする。

【0021】

【課題を解決するための手段】本発明者等は、回転粒子をシート基材に導入した場合、回転粒子の材料如何に依って、透光性液体が充填されたキャビティを生成できない理由の一つとして、回転粒子とシート基材との接着性に原因があることを実験に依って確認した。

【0022】本発明では、回転粒子とシート基材との接着性決定因子の一つである回転粒子材料の臨界表面張力がシート基材の臨界表面張力と比較して同等、若しくは、それ以下にすることが基本になっている。

【0023】前記手段を採ることに依り、回転粒子とシート基材との密着性は低く抑えられて、回転粒子の材料が如何なるものであっても透光性液体が充填されたキャビティを生成させることができ、従って、回転粒子を低エネルギーで回転駆動することが可能となり、高解像度で且つ高速応答性に優れた良好な表示を行うことが可能である。

【0024】

【発明の実施の形態】図1は本発明の製造方法を適用して製造されたシート状表示装置の一例を説明する為の要部切断説明図であり、図に於いて、11は光学的に透明な層からなるシート基材、12はシート基材に形成され且つ透光性液体が充填されたキャビティ、13A、13B、13C・・・は着色層が形成された回転粒子、14は着色層、15は透明共通電極、16A、16B、16C・・・は表示電極、17は駆動回路、17Aは信号入力端、18は電源をそれぞれ示している。

【0025】図示のシート状表示装置に於いて、共通電極15は電源18の正極側に接続され、表示電極16A、16B、16C・・・は駆動回路17を介して電源18の負極側に選択的に接続されるようになっている。

【0026】ここで、駆動回路17の信号入力端17Aから信号が入力された場合、その信号で選択された表示電極、例えば16C、16E、16Fが電源18の負極側に接続されたとした場合、表示電極16C、16E、16Fと共通電極15との間に在る回転粒子13B、13E、13Fには電界が加わって回動し、その着色層14が表示面である共通電極15側に表出された状態となって表示が実現されるものであり、以下、前記構成諸部材について詳細に説明する。

【0027】キャビティ12は透光性液体で満たされ、その中に在る回転粒子13A、13B・・・に於ける着色層14は、反射光の色、反射強度の差などを利用して観察側から見て異なる色相を表示できればよい。

【0028】回転粒子13A、13B・・・の寸法としては、その直径が表示装置の1画素以下の大きさとなるようにすることが必要であり、通常、直径200[μm]以下が選択され、材料としては、前記したように、様々なものを用いることができる。

【0029】シート基材11は、液体に浸漬して膨潤さ

せ、透光性液体を含んだキャビティ12を生成させる為、そのシート基材11の構成材料中に該材料と膨潤度を異にする物質を均一に分散させた液に回転粒子13A等を分散させたものを固化するのであるが、その固化したシート基材11は、更に適切な時間、透光性液体に漬け込んで膨潤させる。

【0030】本発明者等は、シート基材11を液体シリコンが室温で固化する2液性RTV (room temperature vulcanizing) シリコ

粒子材料	①	②	③	④
臨界表面張力 (dyne/cm)	31	33	18.5	25
キャビティの有無	△	×	○	○

(○：有、×：無、△：ばらつきがある)

【0032】この結果からすると、キャビティ12を生成させるには、シート基材11と回転粒子13A等との接着性は低い方が良く、回転粒子13A等の表面に於ける臨界表面張力は、シート基材11の臨界表面張力と同等か、それ以下であることが必要である。

【0033】他の特性上からの要請で、シート基材11との接着性が高い材料を用いた回転粒子13A等を利用しなければならない場合には、回転粒子13A等に対して接着性を低下させるような処理を施してからシート化を行えば良く、その処理は、前記したように表面処理剤で回転粒子13A等をコートするなどの手段を採れば良い。

【0034】表面処理剤としては、シリコン、含フッ素エチレン誘導体、含フッ素スチレン誘導体、フッ素系ポリマなど接着性を低下させる効果があるものならよいが、その他、回転粒子13A等の表示特性に影響を与えることがないこと、薄膜であること、無色透明であること、シート基材11に於ける透光性溶液に溶解すること、溶解に依って特性が影響を受けないことなどの条件を満たすものであることが好ましく、また、フッ素系ポリマをパーフルオロアルキル溶液などの不活性溶液に分散させたものであることが好ましく、更にまた、キャビティの生成後、透光性液体に溶解して除去されるものであることが望ましい。

【0035】表面処理剤は、スピン・コート法、スプレー法、浸漬法などの塗布法を適用して回転粒子13A等に塗布され、その際、回転粒子13A等の融点 T_m や軟化点 T_g に応じて温度を変えた炉に適切な時間だけ入れ、加熱処理して被膜強度を向上させた方がシート形成時に回転粒子13A等と表面処理剤との剥離を低減することができる。

【0036】前記したところから、回転粒子13A等とシート基材11との密着性は低下させることができるの

ーンゴム(臨界表面張力：25 [dyne/cm])に固定し、回転粒子材料として表面の臨界表面張力を異にするもの、即ち、①ポリエチレン樹脂、②ポリスチレン樹脂、③フッ素樹脂、④②に表面処理剤(例えばフッ素)を塗布したものをを用い、キャビティ発生の有無を調査したところ、次表の結果を得ることができた。

【0031】

【表1】

で、回転粒子13A等の材料としていかなるものを選択しても、透光性液体が充填されたキャビティ12を生成させることが可能である。

【0037】透光性液体としては、電気的絶縁性が高い絶縁性液体、又は、高抵抗液体であれば良く、トルエン、アセトン等の有機溶剤や水を用いることも可能であるが、キャビティ中に常に不可欠である液体が逸散しないようにする為、不揮発性の液体を用いることが好ましく、特に、シリコンオイルはイオンや不純物の含有量が低く、高抵抗な液体であるので好ましい。

【0038】液体中の回転粒子13A等は、回転粒子13A等と液体との間で電荷の授受が行われて電気二重層が形成され、回転粒子13A等は正又は負に帯電することが知られている。

【0039】回転粒子13A等に於ける例えば白色部が負に帯電し、着色部が正に帯電するものとした場合、電源18の正極に接続された共通電極15側に回転粒子13A等に於ける白色部側が対向し、また、電源18の負極に選択的に接続された例えば表示電極16A、16B、16D側に着色部側が対向する。

【0040】従って、透明共通電極15側から観察すると、回転粒子13A、13B、13Dの着色部で反射された光、例えば黒色の像が見えることになる。尚、電界の方向を逆転させれば、回転粒子13A等は反転回転し、白色部が観察側に表出されるので、それに依って反射された光、即ち、白色の像が見える。

【0041】前記したように、観察者は共通電極15を介して像を見ることになるので、共通電極15は透明であることが必要であり、従って、共通電極15を構成する材料としては、透明導電材料である SnO_2 、 TiO_2 、 ZnO 、ITO(indium tin oxide)などを用いることができる。

【0042】前記図示説明したシート状表示装置では、

回転粒子の回転を低エネルギーで実施することができ、高解像度で且つ高速応答の表示を行うことができ、しかも、カラー表示も可能であって、表示の品質も優れている。

【0043】また、構成が簡易であること、そして、表示の書き換えは勿論、表示の保持が可能であって、しかも、その保持にはエネルギーは不要である為、限られた電源、即ち、電池を使用しなければならない携帯用機器として好適である。

【0044】更にまた、広い分野に亘って用いることができ、例えばキャラクタ、グラフィック、ビデオ等の画像情報を表示する受光型表示装置として用いたり、また、紙のように取り扱って、見ること、動かすこと、画像を書き込むこと、画像を複写すること、画像を読み込むこと、画像を消去することが可能なペーパー・ディスプレイとして用いることができる。

【0045】〔実施例1〕真空蒸着法を適用することに依り、フッ素樹脂（商品名テフロン：三井デュポン製）粒子にフタロシアニン顔料（商品名TPL-1：オリエント化学工業製）からなる膜を成膜し、半球毎に色と電

【0046】ディップ・コート法を適用することに依り、前記各粒子を撥水撥油剤（表面処理剤）（商品名スミフロン：サカタインクス製）溶液中に浸漬して、厚さ0.2〔μm〕程度の撥水撥油被膜を成膜し、2〔時間〕～3〔時間〕程度の乾燥を行う。

【0047】撥水撥油被膜が剥がれ難くする為、前記乾燥後、温度を100〔℃〕とした炉中で5〔分〕程度の熱処理を行う。

【0048】前記撥水撥油処理を施した2色回転粒子を2液型シリコンゴムKE109（商品名 信越化学製）に分散させ、室温中に48〔時間〕放置して硬化させた。

【0049】シリコンゴムを硬化させた後、このシートをシリコンオイル（商品名SH200、20cS：東レダウコーニングシリコン製）中に60〔時間〕浸漬してキャビティが生成されたことを確認した。

【0050】前記のようにして作製した2色回転粒子を含むキャビティをもつシリコンゴムからなるシートの表裏両面に透明電極を形成し、2色回転粒子に印加する電場をオン・オフしたところ、品質及び応答性に優れた表示を実現し得る性能が確認された。

【0051】〔比較例1〕実施例1に於いて、撥水撥油処理を省略したところ、図2に見られるように、全ての粒子について、フッ素樹脂露出面、即ち、白色部側にキャビティが生成されたが、フタロシアニン顔料を蒸着した着色部側にキャビティを生成することは出来なかった。

【0052】〔実施例2〕真空蒸着法を適用することに依り、ポリエチレン樹脂粒子にフタロシアニン顔料（商

品名TPL-1：オリエント化学工業製）からなる膜を成膜し、半球毎に色と電気的特性を異にする2色回転粒子を作製した。

【0053】ディップ・コート法を適用することに依り、前記各粒子を撥水撥油剤（表面処理剤）（商品名スミフロン：サカタインクス製）溶液中に浸漬して、厚さ0.2〔μm〕程度の撥水撥油被膜を成膜し、2〔時間〕～3〔時間〕程度の乾燥を行う。

【0054】撥水撥油被膜が剥がれ難くする為、前記乾燥後、温度を100〔℃〕とした炉中で5〔分〕程度の熱処理を行う。

【0055】前記撥水撥油処理を施した2色回転粒子を2液型シリコンゴムKE109（商品名 信越化学製）に分散させ、室温中に48〔時間〕放置して硬化させた。

【0056】シリコンゴムを硬化させた後、このシートをシリコンオイル（商品名SH200、20cS：東レダウコーニングシリコン製）中に60〔時間〕浸漬してキャビティが生成されたことを確認した。

【0057】前記のようにして作製した2色回転粒子を含むキャビティをもつシリコンゴムからなるシートの表裏両面に透明電極を形成し、2色回転粒子に印加する電場をオン・オフしたところ、品質及び応答性に優れた表示を実現し得る性能が確認された。

【0058】〔比較例2〕実施例2に於いて、撥水撥油処理を省略したところ、図3に見られるように、ポリエチレン樹脂粒子について、ポリエチレン樹脂露出面、即ち、白色部側にキャビティを生成されたものが幾つか散見されたが、他のポリエチレン樹脂粒子については、白色部側及びフタロシアニン顔料を蒸着した着色部側ともにキャビティを生成することは出来なかった。

【0059】〔実施例3〕真空蒸着法を適用することに依り、架橋型ポリスチレン樹脂（商品名SGP-150C：綜研化学製）粒子に厚さ2〔μm〕のフタロシアニン顔料（商品名TPL-1：オリエント化学工業製）からなる膜を成膜し、半球毎に色と電気的特性を異にする2色回転粒子を作製した。

【0060】ディップ・コート法を適用することに依り、前記各粒子を撥水撥油剤（表面処理剤）（商品名スミフロン：サカタインクス製）溶液中に浸漬して、厚さ0.2〔μm〕程度の撥水撥油被膜を成膜し、2〔時間〕～3〔時間〕程度の乾燥を行う。

【0061】撥水撥油被膜が剥がれ難くする為、前記乾燥後、温度を100〔℃〕とした炉中で5〔分〕程度の熱処理を行う。

【0062】前記撥水撥油処理を施した2色回転粒子を2液型シリコンゴムKE109（商品名 信越化学製）に分散させ、室温中に48〔時間〕放置して硬化させた。

【0063】シリコンゴムを硬化させた後、このシー

トをシリコンオイル（商品名SH200、20cS：東レダウコーニングシリコン製）中に60〔時間〕浸漬してキャビティが生成されたことを確認した。

【0064】前記のようにして作製した2色回転粒子を含むキャビティをもつシリコンゴムからなるシートの表裏両面に透明電極を形成し、2色回転粒子に印加する電場をオン・オフしたところ、品質及び応答性に優れた表示を実現し得る性能が確認された。

【0065】〔比較例3〕実施例3に於いて、撥水撥油処理を省略したところ、全ての粒子について、キャビティを生成することは出来なかった。

【0066】

【発明の効果】本発明に依るシート状表示装置の製造方法に於いては、光学的特性を異にする領域をもつ回転粒子を光学的に透明な層に分散してシートを作製し、そのシートを透光性液体で膨潤させ回転粒子の周囲に透光性液体が充填されたキャビティを生成させてシート基材を作製するに際し、回転粒子として臨界表面張力が前記シート基材の臨界表面張力と同等か若しくはそれ以下の材料を用いる。

【0067】前記構成を採ることに依り、回転粒子とシート基材との密着性は低く抑えられて、回転粒子の材料が如何なるものであっても透光性液体が充填されたキャビティを生成させることができ、従って、回転粒子を低エネルギーで回転駆動することが可能となり、高解像度で且つ高速応答性に優れた良好な表示を行うことが可能で

ある。

【図面の簡単な説明】

【図1】本発明の製造方法を適用して製造されたシート状表示装置の一例を説明する為の要部切断説明図である。

【図2】シート状表示装置の動作を説明する為の要部切断側面図である。

【図3】シート状表示装置の動作を説明する為の要部切断側面図である。

【図4】米国特許として開示された表示媒体を表す要部切断側面図である。

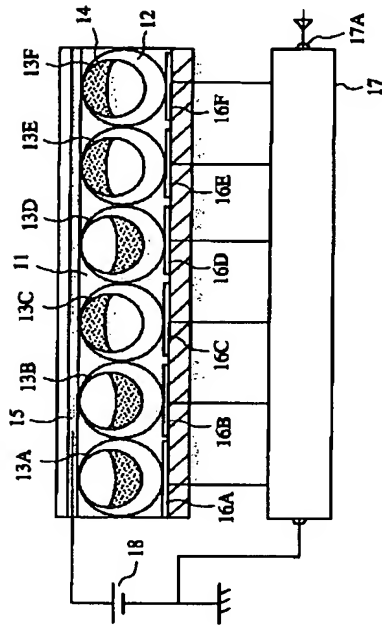
【図5】回転粒子の動きを説明する為の要部切断側面図である。

【符号の説明】

- 11 光学的に透明な層からなるシート基材
- 12 シート基材に形成され且つ透光性液体が充填されたキャビティ
- 13 A, 13 B, 13 C 着色層が形成された回転粒子
- 14 着色層
- 15 透明共通電極
- 16 A, 16 B, 16 C 表示電極
- 17 駆動回路
- 17 A 信号入力端
- 18 電源

【図1】

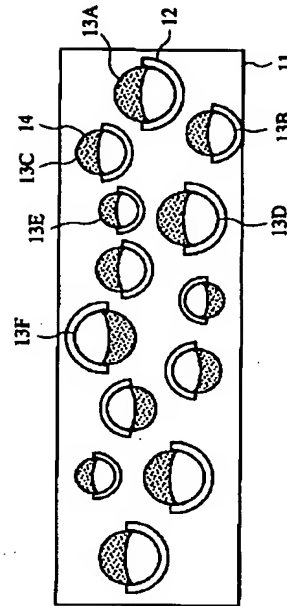
シート状表示装置の要部切断説明図



11: シート基材
12: キャビティ
13A乃至13F: 回転粒子
14: 着色層
15: 透明共通電極
16A乃至16F: 表示電極
17: 駆動回路
17A: 信号入力端
18: 電源

【図2】

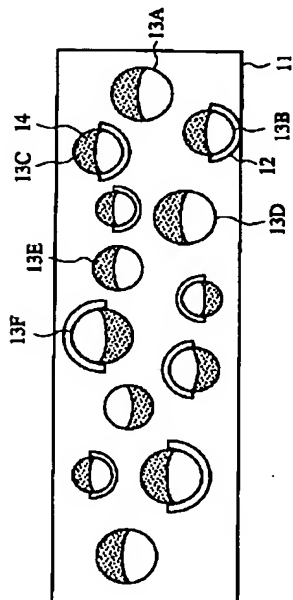
シート状表示装置の要部切断側面図



11: シート基材
12: キャビティ
13A等: 回転粒子
14: 着色層

【図3】

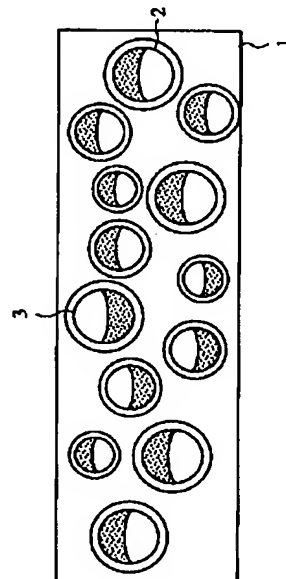
シート状表示装置の要部切断側面図



11: シート基材
12: キャビティ
13A等: 回転粒子
14: 着色層

【図4】

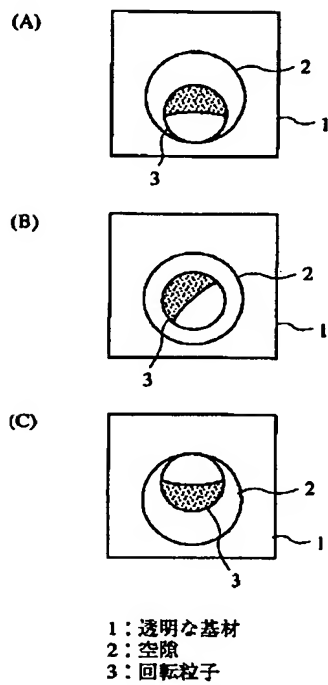
表示媒体の要部切断側面図



1: 透明な基材
2: 空隙
3: 回転粒子

【図5】

回転粒子の動きを説明する為の要部切断側面図



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CLAIMS

[Claim(s)]

[Claim 1] The process which distributes optically the rotation particle which has the field which differs in an optical property in a front face in a transparent layer, and produces a sheet, And it sets to the manufacture approach of a sheet-like display including the process which is made to generate the cavity with which the translucency liquid was therefore made to swell said sheet, and said translucency liquid was filled up into the perimeter of said rotation particle, and produces a sheet base material. said rotation particle -- critical surface tension -- the critical surface tension and the EQC of said sheet base material -- or the manufacture approach of the sheet-like display characterized by consisting of an ingredient which is less than [it].

[Claim 2] the front face of a rotation particle -- critical surface tension -- the critical surface tension and the EQC of a sheet base material -- or the manufacture approach of the sheet-like display according to claim 1 characterized by forming the ingredient layer which is less than [it].

[Claim 3] The manufacture approach of the sheet-like display according to claim 2 characterized by an ingredient layer consisting of an ingredient which dissolves in a translucency liquid.

[Claim 4] The manufacture approach of the sheet-like display according to claim 2 characterized by forming an ingredient layer by the fluorine system polymer distributed in the inactive solution.

[Claim 5] The manufacture approach of the sheet-like display according to claim 2 characterized by adding heat treatment for inhibiting exfoliation after forming an ingredient layer.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the improvement of an approach which manufactures the sheet-like display of the structure where formed two or more openings which filled up the transparent base material with the translucency liquid optically, and the rotation particle for a display was made inherent all over this opening.

[0002]

[Description of the Prior Art] Generally, it is called a paper[an electronic paper and]-like display, a digital paper, etc., therefore, optical absorption or optical reflection is changed to impression of electric field, and the sheet-like display (medium) which performs an image display is known.

[0003] for example, in the patent No. 2551783 official report (Japanese Patent Application No. No. 244679 [62 to]) The solvent which distributed the electrophoresis particle is colored as a component which depends on electric field and changes optical absorption and optical reflection. The microcapsule which connoted this solvent is indicated. To JP,8-234686,A (Japanese Patent Application No. No. 343133 [seven to]) The microcapsule which connoted the body of revolution which doubled the semi-sphere which differs in a color and electrical characteristics, and was combined is indicated, and the liquid crystal / macromolecule bipolar membrane which contains further the dichroism coloring matter from which a color changes by electric field, and a smectic liquid crystal are known.

[0004] The above mentioned display can hold image information, even if it has memory nature and a power source is intercepted, and since it is a reflective mold display, it is expected as an alternative of the paper in which periodic duty is possible, and since it is obtained by applying on the PET (polyethyleneterephthalate) film with which the electrode was formed when creating, it is thinly realized as a light flexible sheet-like object further again.

[0005] It is known that especially the display medium indicated by the U.S. Pat. No. 4,126,854 specification and the 4,143,103 specification shows the outstanding contrast property as compared with other display media using the rotation particle divided into a color and an electrification property different a semi-sphere every.

[0006] The opening where drawing 4 was an important section cutting side elevation showing the display medium indicated as an United States patent, and drawing 5 is an important section cutting side elevation for explaining a motion of a rotation particle, and the base material with which 1 consists of a transparent layer optically in drawing, and 2 were formed in a base material, and it was filled up with a translucency liquid, and 3 show the rotation particle divided into two fields with a different color and a different different electrification property, respectively.

[0007] Since the display medium has taken said configuration, the electrophoresis of a rotation particle and rotation take place by impressing electric field, and it can display an image. In addition, not only two colors but the multiple-color-ized thing, such as distinguishing by different color with in three colors or four colors, is proposed as a rotation particle.

[0008] As the method of manufacturing said rotation particle, and an ingredient (1) The fused wax particle which is two kinds from which a color differs is combined, the approach of

solidifying, after conglobating therefore to surface tension is indicated by the U.S. Pat. No. 5,262,908 specification, and carnauba wax, carbon black, and titanium oxide are mentioned in it as the ingredient.

[0009] (2) Vacuum evaporation or the approach of applying is indicated in a metal, carbon black, an antimony sulfide, etc. on the front face in the particle of light transmission nature by JP,11-85067,A (Japanese Patent Application No. No. 246738 [nine to]), and JP,11-85068,A (Japanese Patent Application No. No. 246739 [nine to]), and glass and resin are mentioned to them as the ingredient.

[0010] (3) The method of making it color by performing exposure, development, and fixing processing is indicated by JP,11-85069,A (Japanese Patent Application No. No. 248527 [nine to]), and JP,11-161206,A (Japanese Patent Application No. No. 330135 [nine to]) using the particle which consists of a sensitization agent, and the zinc oxide (a color coupler is a toner) and the hydrophilic macromolecule (a color coupler is a silver halide) are mentioned to them as the ingredient. ** is known.

[0011] In addition, as the ingredient which constitutes a rotation particle, for example, resin, a wax, a coloring agent, etc. are changed variously or a rotation particle can be rotated by low energy, in order that high-speed responsibility may give a good indication with high resolution, many researches and developments are made.

[0012] As a principal component of the rotation particle 3, although resin, such as polystyrene, the poly acrylic, and polyethylene, or glass is used The matter with easy control of the configuration from manufacturability, classification by color, electrification controllability, etc. is desirable. From kinematic control, such as rotation of the rotation particle 3, and a halt, to moreover, an electrification controllability it is extent which in addition to the controllability of a configuration and magnitude being easy specific gravity is also important, and it is still more chemically stable, and is insoluble into a certain kind of translucency liquid especially, or can be disregarded -- etc. -- it is required for an interaction to be the small matter.

[0013] Incidentally, the rotation particle with said property is useful also to the translucency liquid used by this invention, and the wax-like matter whose molecular weight is 50000 or less and whose specific gravity is 0.70-1.20 is suitable for it as such matter.

[0014] As above wax-like matter, stearin acid, a palmitic acid, Higher fatty acids, such as a myristic acid and a lauric acid, aluminum stearate, Higher-fatty-acid metal salts, such as a stearin acid potassium and palmitic-acid zinc, The dielectrics of higher fatty acids, such as hydrogenation castor oil, cocoa fat, methyl hydroxystearate, and glycerol mono-hydroxystearate Haze wax, a dense low, carnauba wax, a micro crystallin wax, They are an olefin polymer, copolymers, etc. of low molecular weight, such as wax [, such as paraffin wax,], polyethylene, polypropylene, ethylene-vinylacetate copolymer, and ethylene-vinyl alkyl ether.

[0015] It depends on distributing the above mentioned rotation particle to elastomers, such as silicone rubber, and making an opening (cavity), and a sheet-like display medium is obtained.

[0016] Although it is fully mixed with the silicone rubber before crosslinking reaction (liquefied), and a rotation particle is distributed, this dispersed system is spread tabular or in the shape of film and crosslinking reaction of the silicone rubber is carried out after that, in the rotation particle distribution silicone rubber created by doing in this way, a cavity does not exist in the perimeter of a rotation particle.

[0017] it is immersed into a translucency liquid and the plate of the rotation particle distribution silicone rubber which is the above, and was made and created is suitable -- time amount neglect is carried out.

[0018] Then, since the molecule of a translucency liquid invades into a silicone rubber molecule, silicone rubber is swollen, but since the rotation particle is insoluble into a translucency liquid or osmosis of the translucency liquid to a rotation particle is very slow, a cavity is generated around a rotation particle and, moreover, this opening is filled with a translucency liquid.

[0019] By the way, as an ingredient of a rotation particle, in order to enable the image display of high quality, selection use of the thing of various classes was carried out, but if the ingredient of a rotation particle depended how when it introduced into a sheet base material, there was a problem of a purport that the cavity with which the translucency liquid was filled up could not be

made to generate.

[0020]

[Problem(s) to be Solved by the Invention] The adhesive property between a rotation particle and a sheet base material is reduced with an easy means, and how of a rotation particle ingredient is not asked, but it enables it to make the cavity with which the translucency liquid was filled up generate certainly in this invention.

[0021]

[Means for Solving the Problem] the case where this invention person etc. introduces a rotation particle into a sheet base material -- the ingredient of a rotation particle, therefore, it checked to the experiment that a cause was in the adhesive property of a rotation particle and a sheet base material as one of the reasons which cannot generate the cavity with which the translucency liquid was therefore filled up into how.

[0022] In this invention, it has been to the base that the critical surface tension of the rotation particle ingredient which is one of the adhesive determinants of a rotation particle and a sheet base material makes it an EQC or less than [it] as compared with the critical surface tension of a sheet base material.

[0023] It is possible to perform the good display which it becomes possible for it to depend on taking said means and for the adhesion of a rotation particle and a sheet base material to be suppressed low, to be able to make the cavity with which the translucency liquid was filled up generate no matter the ingredient of a rotation particle may be what thing, therefore to carry out the rotation drive of the rotation particle by low energy, and is high resolution, and was excellent in high-speed responsibility.

[0024]

[Embodiment of the Invention] Drawing 1 is an important section cutting explanatory view for explaining an example of the sheet-like display manufactured with the application of the manufacture approach of this invention. The sheet base material with which 11 consists of a transparent layer optically in drawing, the cavity with which 12 was formed in the sheet base material, and the translucency liquid was filled up, 13A, 13B, the rotation particle in which, as for ..., the coloring layer was formed 13 C, and 14 -- a coloring layer and 15 -- a transparence common electrode, and 16A and 16B -- 16 C, in a display electrode and 17, a drive circuit and 17A show a signal input edge, and 18 shows [....] the power source, respectively.

[0025] the common electrode 15 is connected to the positive-electrode side of a power source 18 in the sheet-like display of illustration -- having -- the display electrodes 16A and 16B is alternatively connected to the negative-electrode side of a power source 18 through the drive circuit 17 16 C.

[0026] When a signal is inputted from signal input edge 17A of the drive circuit 17 here, When it is presupposed that the display electrode, 16C, 16E, and 16F, chosen by the signal was connected to the negative-electrode side of a power source 18, [for example,] Rotation particle 13B between the display electrodes 16C, 16E, and 16F and the common electrode 15, Electric field join 13E and 13F, and it rotates, and the coloring layer 14 will be in the condition of having been expressed at the common electrode 15 side which is the screen, a display is realized, and said many configuration members are hereafter explained to a detail.

[0027] the rotation particles 13A and 13B which a cavity 12 is filled with a translucency liquid and are in it -- the coloring layer 14 in just displays a hue which sees and is different from an observation side using the color of the reflected light, the difference of reflectivity, etc.

[0028] Rotation particles 13A and 13B As a dimension, it is required to make it the diameter serve as magnitude of 1 pixel or less of a display, and below the diameter 200 [mum] is chosen, and as an ingredient, as described above, various things can usually be used.

[0029] The sheet base material 11 is immersed in a liquid, it is made to swell it, although the thing which made the liquid which made homogeneity distribute the matter which differs in this ingredient and a degree of swelling in the component of the sheet base material 11 distribute rotation particle 13A etc. is solidified in order to make the cavity 12 containing a translucency liquid generate, the solidified sheet base material 11 is soaked in still more suitable time amount and a translucency liquid, and they are made to swell it.

[0030] this invention person etc. is fixed to the 2 acidity-or-alkalinity RTV (room temperature vulcanizing) silicone rubber (critical surface tension: 25 [dyne/cm]) with which liquid silicone solidifies the sheet base material 11 at a room temperature. When the existence of cavity generating was investigated using what differs in surface critical surface tension as a rotation particle ingredient, i.e., ** polyethylene resin, ** polystyrene resin, ** fluororesin, and the thing that applied the finishing agent (for example, fluorine) to ****, the result of degree table was able to be obtained.

[0031]

[Table 1]

粒子材料	①	②	③	④
臨界面張力 (dyne/cm)	31	33	18.5	25
キャビティの有無	△	×	○	○

(○ : 有、 × : 無、 △ : ばらつきがある)

[0032] In order to make a cavity 12 generate considering this result, the lower one of the adhesive property of the sheet base material 11, rotation particle 13A, etc. is good, and the critical surface tension in front faces, such as rotation particle 13A, needs to be less than [the critical surface tension and the EQC of the sheet base material 11, and it].

[0033] The processing should just take means, such as carrying out the coat of the rotation particle 13A etc. by the finishing agent, as described above, that what is necessary is just to perform sheet-ization after performing processing to which an adhesive property is reduced to rotation particle 13A etc. at the request from other properties when rotation particle 13A using an ingredient with a high adhesive property with the sheet base material 11 etc. must be used.

[0034] As a finishing agent, silicone, a fluorine-containing ethylene derivative, a fluorine-containing styrene derivative, Be [easy although / it] it is effective in reducing adhesive properties, such as a fluorine system polymer, display properties, such as rotation particle 13A, are not affected, It dissolves [that it is a thin film, a transparent and colorless thing,] in the translucency solution in the sheet base material 11, It is desirable that it is what fulfills conditions, like a property therefore does not receive effect in the dissolution. Moreover, it is desirable to make inactive solutions, such as a perfluoroalkyl solution, distribute a fluorine system polymer, and it is desirable that it is what dissolves in a translucency liquid and is removed after generation of a cavity further again.

[0035] It is applied to rotation particle 13A etc. with the application of the applying methods, such as the spin coat method, a spray method, and dip coating, and finishing agents are the melting points Tg, such as rotation particle 13A, in that case. Softening temperature Tm The direction which only the suitable time amount for the furnace which responded and changed temperature was put in and heat-treated [direction], and raised coat reinforcement can reduce exfoliation with rotation particle 13A etc. and a finishing agent at the time of sheet formation.

[0036] Since the adhesion of rotation particle 13A etc. and the sheet base material 11 can be reduced from the above mentioned place, no matter what thing it may choose as ingredients, such as rotation particle 13A, it is possible to make the cavity 12 with which the translucency liquid was filled up generate.

[0037] using the liquid of a non-volatile, in order for the always indispensable liquid in a cavity not to carry out fly off although it is [that electric insulation should just be a high insulating liquid or a high resistance liquid as a translucency liquid] also possible to use organic solvents and water, such as toluene and an acetone, -- desirable -- especially -- silicone oil -- the content of ion or an impurity -- low -- high -- since it is a liquid [****], it is desirable.

[0038] Transfer of a charge is performed between rotation particle 13A etc. and a liquid, as for rotation particle 13A in a liquid etc., an electric double layer is formed, and it is known that rotation particle 13A etc. will be charged in forward or negative.

[0039] When it considers as the thing in rotation particle 13A etc. in which the white section is charged in negative, for example, and the coloring section is just charged, a coloring section side counters the display electrode [which the white section side in rotation particle 13A etc. countered the common electrode 15 side connected to the positive electrode of a power source 18, and were alternatively connected to the negative electrode of a power source 18]A [16] and 16B, and 16D side.

[0040] Therefore, when it observes from the transparence common electrode 15 side, the light reflected in the coloring section of the rotation particles 13A, 13B, and 13D, for example, a black image, will be visible. In addition, if the direction of electric field is reversed, since rotation particle 13A etc. will carry out reversal rotation and the white section will be expressed at an observation side, the light therefore reflected in it, i.e., a white image, is visible.

[0041] Since an observer will look at an image through the common electrode 15 as described above, the common electrode 15 needs a transparent thing, therefore SnO₂ which is a transparence electrical conducting material, TiO₂, ZnO, ITO (indium tin oxide), etc. can be used as an ingredient which constitutes the common electrode 15.

[0042] A rotation particle can be rotated by low energy, it is high resolution and a high-speed response can be displayed, moreover, color display is also possible and the quality of a display is also excellent in said sheet-like display which gave illustration explanation.

[0043] Moreover, as well as that a configuration is simple and rewriting of a display, since energy is unnecessary to the maintenance, it is suitable [maintenance of a display is possible, and] for it as the limited power source, i.e., a portable equipment which must use a cell.

[0044] Furthermore, it can use as a light-receiving mold display which can continue and use for a large field again, for example, displays image information, such as a character, a graphic, and video, and can use as a paper display which can eliminate [dealing with it like paper and seeing, moving, writing in an image, copying an image, reading an image and] an image.

[0045] [Example 1] It depended on applying vacuum evaporation technique, the film which becomes a fluororesin (trade-name Teflon: Mitsui E. I. du Pont de Nemours make) particle from a phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) was formed, and 2 color rotation particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0046] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0047] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0048] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color rotation particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0049] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make), and the cavity had been generated.

[0050] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color rotation particle which is the above, and was made and produced, and when the electric field impressed to 2 color rotation particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0051] [Example 1 of a comparison] In the example 1, although the cavity was generated about all particles at the fluororesin exposure, i.e., the white section, side so that drawing 2 might see when water-repellent oil-repellent processing was omitted, the cavity was ungenerable to the coloring section side which vapor-deposited the phthalocyanine pigment.

[0052] [Example 2] It depended on applying vacuum evaporation technique, the film which

becomes a polyethylene resin particle from a phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) was formed, and 2 color rotation particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0053] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0054] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0055] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color rotation particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0056] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make), and the cavity had been generated.

[0057] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color rotation particle which is the above, and was made and produced, and when the electric field impressed to 2 color rotation particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0058] [Example 2 of a comparison] In the example 2, although some things which had the cavity generated to a polyethylene resin exposure, i.e., the white section, side appeared here and there about the polyethylene resin particle so that drawing 3 might see when water-repellent oil-repellent processing was omitted, about other polyethylene resin particles, the coloring section side which vapor-deposited the white section side and the phthalocyanine pigment was not able to generate a cavity.

[0059] [Example 3] It depended on applying vacuum evaporation technique, the film which becomes a bridge formation mold polystyrene resin (trade-name SGP-150C: Soken Chemical & Engineering make) particle from the phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) of thickness 2 [μm] was formed, and 2 color rotation particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0060] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0061] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0062] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color rotation particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0063] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make), and the cavity had been generated.

[0064] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color rotation particle which is the above, and was made and produced, and when the electric field impressed to 2 color rotation particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0065] [Example 3 of a comparison] In the example 3, when water-repellent oil-repellent

processing was omitted, the cavity was ungenerable about no particles.

[0066]

[Effect of the Invention] in the manufacture approach of the sheet-like display which depends on this invention, the cavity with which distributed optically the rotation particle with the field which differs in an optical property in the transparent layer, produced the sheet, the sheet was made to swell with a translucency liquid, and the translucency liquid was filled up into the perimeter of a rotation particle generates -- making -- a sheet base material -- producing -- facing -- as a rotation particle -- critical surface tension -- the critical surface tension and the EQC of said sheet base material -- or the ingredient not more than it uses.

[0067] It is possible to perform the good display which it becomes possible for it to depend on taking said configuration and for the adhesion of a rotation particle and a sheet base material to be suppressed low, to be able to make the cavity with which the translucency liquid was filled up generate no matter the ingredient of a rotation particle may be what thing, therefore to carry out the rotation drive of the rotation particle by low energy, and is high resolution, and was excellent in high-speed responsibility.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the improvement of an approach which manufactures the sheet-like display of the structure where formed two or more openings which filled up the transparent base material with the translucency liquid optically, and the revolution particle for a display was made inherent all over this opening.

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PRIOR ART

[Description of the Prior Art] Generally, it is called a paper[an electronic paper and]-like display, a digital paper, etc., therefore, optical absorption or an optical echo is changed to impression of electric field, and the sheet-like display (medium) which performs an image display is known.

[0003] for example, in the patent No. 2551783 official report (Japanese Patent Application No. No. 244679 [62 to]) The solvent which distributed the electrophoresis particle is colored as a component which depends on electric field and changes optical absorption and an optical echo. The microcapsule which connoted this solvent is indicated. To JP,8-234686,A (Japanese Patent Application No. No. 343133 [seven to]) The microcapsule which connoted the body of revolution which doubled the semi-sphere which differs in a color and electrical characteristics, and was combined is indicated, and the liquid crystal / macromolecule bipolar membrane which contains further the dichroism coloring matter from which a color changes by electric field, and a smectic liquid crystal are known.

[0004] The above mentioned display can hold image information, even if it has memory nature and a power source is intercepted, and since it is a reflective mold display, it is expected as an alternative of the paper in which periodic duty is possible, and since it is obtained by applying on the PET (polyethyleneterephthalate) film with which the electrode was formed when creating, it is thinly realized as a light flexible sheet-like object further again.

[0005] It is known that especially the display medium indicated by the U.S. Pat. No. 4,126,854 description and the 4,143,103 description shows the outstanding contrast property as compared with other display media using the revolution particle divided into a color and an electrification property different a semi-sphere every.

[0006] The opening where drawing 4 was an important section cutting side elevation showing the display medium indicated as an United States patent, and drawing 5 is an important section cutting side elevation for explaining a motion of a revolution particle, and the base material with which 1 consists of a transparent layer optically in drawing, and 2 were formed in a base material, and it was filled up with a translucency liquid, and 3 show the revolution particle divided into two fields with a different color and a different different electrification property, respectively.

[0007] Since the display medium has taken said configuration, the electrophoresis of a revolution particle and rotation take place by impressing electric field, and it can display an image. In addition, not only two colors but the multiple-color-ized thing, such as distinguishing by different color with in three colors or four colors, is proposed as a revolution particle.

[0008] As the method of manufacturing said revolution particle, and an ingredient (1) The fused wax particle which is two kinds from which a color differs is combined, the approach of solidifying, after conglobating therefore to surface tension is indicated by the U.S. Pat. No. 5,262,908 description, and carnauba wax, carbon black, and titanium oxide are mentioned in it as the ingredient.

[0009] (2) Vacuum evaporation or the approach of applying is indicated in a metal, carbon black, an antimony sulfide, etc. on the front face in the particle of light transmission nature by JP,11-85067,A (Japanese Patent Application No. No. 246738 [nine to]), and JP,11-85068,A (Japanese Patent Application No. No. 246739 [nine to]), and glass and resin are mentioned to them as the

ingredient.

[0010] (3) The method of making it color by performing exposure, development, and fixation processing is indicated by JP,11-85069,A (Japanese Patent Application No. No. 248527 [nine to]), and JP,11-161206,A (Japanese Patent Application No. No. 330135 [nine to]) using the particle which consists of a sensitization agent, and the zinc oxide (a color coupler is a toner) and the hydrophilic macromolecule (a color coupler is a silver halide) are mentioned to them as the ingredient. ** is known.

[0011] In addition, as the ingredient which constitutes a revolution particle, for example, resin, a wax, a coloring agent, etc. are changed variously or a revolution particle can be rotated by low energy, in order that high-speed responsibility may give a good indication with high resolution, many researches and developments are made.

[0012] As a principal component of the revolution particle 3, although resin, such as polystyrene, the poly acrylic, and polyethylene, or glass is used The matter with easy control of the configuration from manufacturability, classification by color, electrification controllability, etc. is desirable. From kinematic control, such as a revolution of the revolution particle 3, and a halt, to moreover, an electrification controllability it is extent which in addition to the controllability of a configuration and magnitude being easy specific gravity is also important, and it is still more chemically stable, and is insoluble into a certain kind of translucency liquid especially, or can be disregarded -- etc. -- it is required for an interaction to be the small matter.

[0013] Incidentally, the revolution particle with said property is useful also to the translucency liquid used by this invention, and the wax-like matter whose molecular weight is 50000 or less and whose specific gravity is 0.70-1.20 is suitable for it as such matter.

[0014] As above wax-like matter, stearin acid, a palmitic acid, Higher fatty acids, such as a myristic acid and a lauric acid, aluminum stearate, Higher-fatty-acid metal salts, such as a stearin acid potassium and palmitic-acid zinc, The dielectrics of higher fatty acids, such as hydrogenation castor oil, cocoa fat, methyl hydroxystearate, and glycerol mono-hydroxystearate Haze wax, a dense low, carnauba wax, a micro crystallin wax, They are an olefin polymer, copolymers, etc. of low molecular weight, such as wax [, such as paraffin wax,], polyethylene, polypropylene, ethylene-vinylacetate copolymer, and ethylene-vinyl alkyl ether.

[0015] It depends on distributing the above mentioned revolution particle to elastomers, such as silicone rubber, and making an opening (cavity), and a sheet-like display medium is obtained.

[0016] Although it is fully mixed with the silicone rubber before crosslinking reaction (liquefied), and a revolution particle is distributed, this dispersed system is spread tabular or in the shape of film and crosslinking reaction of the silicone rubber is carried out after that, in the revolution particle distribution silicone rubber created by doing in this way, a cavity does not exist in the perimeter of a revolution particle.

[0017] it is immersed into a translucency liquid and the plate of the revolution particle distribution silicone rubber which is the above, and was made and created is suitable -- time amount neglect is carried out.

[0018] Then, since the molecule of a translucency liquid invades into a silicone rubber molecule, silicone rubber is swollen, but since the revolution particle is insoluble into a translucency liquid or osmosis of the translucency liquid to a revolution particle is very slow, a cavity is generated around a revolution particle and, moreover, this opening is filled with a translucency liquid.

[0019] By the way, as an ingredient of a revolution particle, in order to enable the image display of high quality, the selection activity of the thing of various classes was carried out, but if the ingredient of a revolution particle depended how when it introduced into a sheet base material, there was a problem of a purport that the cavity with which the translucency liquid was filled up could not be made to generate.

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EFFECT OF THE INVENTION

[Effect of the Invention] in the manufacture approach of the sheet-like display which depends on this invention, the cavity with which distributed optically the revolution particle with the field which differs in an optical property in the transparent layer, produced the sheet, the sheet was made to swell with a translucency liquid, and the translucency liquid was filled up into the perimeter of a revolution particle generates -- making -- a sheet base material -- producing -- facing -- as a revolution particle -- critical surface tension -- the critical surface tension and the EQC of said sheet base material -- or the ingredient not more than it uses.

[0067] It is possible to perform the good display which it becomes possible for it to depend on taking said configuration and for the adhesion of a revolution particle and a sheet base material to be suppressed low, to be able to make the cavity with which the translucency liquid was filled up generate no matter the ingredient of a revolution particle may be what thing, therefore to carry out revolution actuation of the revolution particle by low energy, and is high resolution, and was excellent in high-speed responsibility.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The adhesive property between a revolution particle and a sheet base material is reduced with an easy means, and how of a revolution particle ingredient is not asked, but it enables it to make the cavity with which the translucency liquid was filled up generate certainly in this invention.
[0021]

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MEANS

[Means for Solving the Problem] the case where this invention person etc. introduces a revolution particle into a sheet base material -- the ingredient of a revolution particle, therefore, it checked to the experiment that a cause was in the adhesive property of a revolution particle and a sheet base material as one of the reasons which cannot generate the cavity with which the translucency liquid was therefore filled up into how.

[0022] In this invention, it has been to bases that the critical surface tension of the revolution particle ingredient which is one of the adhesive determinants of a revolution particle and a sheet base material makes it an EQC or less than [it] as compared with the critical surface tension of a sheet base material.

[0023] It is possible to perform the good display which it becomes possible for it to depend on taking said means and for the adhesion of a revolution particle and a sheet base material to be suppressed low, to be able to make the cavity with which the translucency liquid was filled up generate no matter the ingredient of a revolution particle may be what thing, therefore to carry out revolution actuation of the revolution particle by low energy, and is high resolution, and was excellent in high-speed responsibility.

[0024]

[Embodiment of the Invention] Drawing 1 is an important section cutting explanatory view for explaining an example of the sheet-like display manufactured with the application of the manufacture approach of this invention. The sheet base material with which 11 consists of a transparent layer optically in drawing, the cavity with which 12 was formed in the sheet base material, and the translucency liquid was filled up, 13A, 13B, the revolution particle in which, as for, the coloring layer was formed 13 C, and 14 -- a coloring layer and 15 -- a transparency common electrode, and 16A and 16B -- 16 C, in a display electrode and 17, an actuation circuit and 17A show a signal input edge, and 18 shows [...] the power source, respectively.

[0025] the common electrode 15 is connected to the positive-electrode side of a power source 18 in the sheet-like display of a graphic display -- having -- the display electrodes 16A and 16B is selectively connected to the negative-electrode side of a power source 18 through the actuation circuit 17 16 C.

[0026] When a signal is inputted from signal input edge 17A of the actuation circuit 17 here, When it is presupposed that the display electrode, 16C, 16E, and 16F, chosen by the signal was connected to the negative-electrode side of a power source 18, [for example,] Revolution particle 13B between the display electrodes 16C, 16E, and 16F and the common electrode 15, Electric field join 13E and 13F, and it rotates, and the coloring layer 14 will be in the condition of having been expressed at the common electrode 15 side which is the screen, a display is realized, and said many configuration members are hereafter explained to a detail.

[0027] the revolution particles 13A and 13B which a cavity 12 is filled with a translucency liquid and are in it -- the coloring layer 14 in just displays a hue which sees and is different from an observation side using the color of the reflected light, the difference of reflectivity, etc.

[0028] Revolution particles 13A and 13B As a dimension, it is required to make it the diameter serve as magnitude of 1 pixel or less of a display, and below the diameter 200 [μm] is chosen, and as an ingredient, as described above, various things can usually be used.

[0029] The sheet base material 11 is immersed in a liquid, it is made to swell it, although the thing which made the liquid which made homogeneity distribute the matter which differs in this ingredient and a degree of swelling in the component of the sheet base material 11 distribute revolution particle 13A etc. is solidified in order to make the cavity 12 containing a translucency liquid generate, the solidified sheet base material 11 is soaked in still more suitable time amount and a translucency liquid, and they make swell it.

[0030] this invention person etc. is fixed to the 2 acidity-or-alkalinity RTV (room temperature vulcanizing) silicone rubber (critical surface tension: 25 [dyne/cm]) with which liquid silicone solidifies the sheet base material 11 at a room temperature. When the existence of cavity generating was investigated using what differs in surface critical surface tension as a revolution particle ingredient, i.e., ** polyethylene resin, ** polystyrene resin, ** fluororesin, and the thing that applied the finishing agent (for example, fluorine) to ****, the result of degree table was able to be obtained.

[0031]

[A table 1]

粒子材料	①	②	③	④
臨界表面張力 (dyne/cm)	31	33	18.5	25
キャビティの有無	△	×	○	○

(○ : 有、 × : 無、 △ : ばらつきがある)

[0032] In order to make a cavity 12 generate considering this result, the lower one of the adhesive property of the sheet base material 11, revolution particle 13A, etc. is good, and the critical surface tension in front faces, such as revolution particle 13A, needs to be less than [the critical surface tension and the EQC of the sheet base material 11, and it].

[0033] The processing should just take means, such as carrying out the coat of the revolution particle 13A etc. by the finishing agent, as described above, that what is necessary is just to perform sheet-ization after performing processing to which an adhesive property is reduced to revolution particle 13A etc. at the request from other properties when revolution particle 13A using an ingredient with a high adhesive property with the sheet base material 11 etc. must be used.

[0034] As a finishing agent, silicone, a fluorine-containing ethylene derivative, a fluorine-containing styrene derivative, Be [easy although / it] it is effective in reducing adhesive properties, such as a fluorine system polymer, display properties, such as revolution particle 13A, are not affected, It dissolves [that it is a thin film, a transparent and colorless thing,] in the translucency solution in the sheet base material 11, It is desirable that it is what fulfills conditions, like a property therefore does not receive effect in the dissolution. Moreover, it is desirable to make inactive solutions, such as a perfluoroalkyl solution, distribute a fluorine system polymer, and it is desirable that it is what dissolves in a translucency liquid and is removed after generation of a cavity further again.

[0035] It is applied to revolution particle 13A etc. with the application of the applying methods, such as the spin coat method, a spray method, and dip coating, and finishing agents are the melting points Tg, such as revolution particle 13A, in that case. Softening temperature Tm The direction which only the suitable time amount for the furnace which responded and changed temperature was put in and heat-treated [direction], and raised coat reinforcement can reduce exfoliation with revolution particle 13A etc. and a finishing agent at the time of sheet formation.

[0036] Since the adhesion of revolution particle 13A etc. and the sheet base material 11 can be reduced from the above mentioned place, no matter what thing it may choose as ingredients, such as revolution particle 13A, it is possible to make the cavity 12 with which the translucency liquid was filled up generate.

[0037] using the liquid of a non-volatile, in order for the always indispensable liquid in a cavity

not to carry out fly off although it is [that electric insulation should just be a high insulating liquid or a high resistance liquid as a translucency liquid] also possible to use organic solvents and water, such as toluene and an acetone, -- desirable -- especially -- silicone oil -- the content of ion or an impurity -- low -- high -- since it is a liquid [****], it is desirable.

[0038] Transfer of a charge is performed between revolution particle 13A etc. and a liquid, as for revolution particle 13A in a liquid etc., an electric double layer is formed, and it is known that revolution particle 13A etc. will be charged in forward or negative.

[0039] When it considers as the thing in revolution particle 13A etc. in which the white section is charged in negative, for example, and the coloring section is just charged, a coloring section side counters the display electrode [which the white section side in revolution particle 13A etc. countered the common electrode 15 side connected to the positive electrode of a power source 18, and were selectively connected to the negative electrode of a power source 18]A [16] and 16B, and 16D side.

[0040] Therefore, when it observes from the transparence common electrode 15 side, the light reflected in the coloring section of the revolution particles 13A, 13B, and 13D, for example, a black image, will be visible. In addition, if the direction of electric field is reversed, since revolution particle 13A etc. will carry out reversal rotation and the white section will be expressed at an observation side, the light therefore reflected in it, i.e., a white image, is visible.

[0041] Since an observer will look at an image through the common electrode 15 as described above, the common electrode 15 needs a transparent thing, therefore SnO₂ which is a transparence electrical conducting material, TiO₂, ZnO, ITO (indium tin oxide), etc. can be used as an ingredient which constitutes the common electrode 15.

[0042] A revolution particle can be rotated by low energy, it is high resolution and a high-speed response can be displayed, moreover, color display is also possible and the quality of a display is also excellent in said sheet-like display which gave graphic display explanation.

[0043] Moreover, as well as that a configuration is simple and rewriting of a display, since energy is unnecessary to the maintenance, it is suitable [maintenance of a display is possible, and] for it as the limited power source, i.e., a portable equipment which must use a cell.

[0044] Furthermore, it can use as a light-receiving mold display which can use [a large field] again, for example, displays image information, such as a character, a graphic, and video, and can use as a paper display which can eliminate [dealing with it like paper and seeing, moving, writing in an image, copying an image, reading an image and] an image.

[0045] [Example 1] It depended on applying vacuum evaporation technique, the film which becomes a fluororesin (trade-name Teflon: Mitsui E. I. du Pont de Nemours make) particle from a phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) was formed, and 2 color revolution particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0046] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0047] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0048] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color revolution particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0049] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make), and the cavity had been generated.

[0050] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color revolution particle which is the above, and was made and produced, and when the electric field impressed to 2 color revolution

particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0051] [Example 1 of a comparison] In the example 1, although the cavity was generated about all particles at the fluororesin exposed-surface, i.e., the white section, side so that drawing 2 might see when water-repellent oil-repellent processing was omitted, the cavity was ungenerable to the coloring section side which vapor-deposited the phthalocyanine pigment.

[0052] [Example 2] It depended on applying vacuum evaporation technique, the film which becomes a polyethylene resin particle from a phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) was formed, and 2 color revolution particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0053] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0054] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0055] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color revolution particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0056] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make), and the cavity had been generated.

[0057] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color revolution particle which is the above, and was made and produced, and when the electric field impressed to 2 color revolution particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0058] [Example 2 of a comparison] In the example 2, although some things which had the cavity generated to a polyethylene resin exposed-surface, i.e., the white section, side appeared here and there about the polyethylene resin particle so that drawing 3 might see when water-repellent oil-repellent processing was omitted, about other polyethylene resin particles, the coloring section side which vapor-deposited the white section side and the phthalocyanine pigment was not able to generate a cavity.

[0059] [Example 3] It depended on applying vacuum evaporation technique, the film which becomes a bridge formation mold polystyrene resin (trade-name SGP-150C: Soken Chemical & Engineering make) particle from the phthalocyanine pigment (trade-name TPL-1: product made from the ORIENT chemical industry) of thickness 2 [μm] was formed, and 2 color revolution particle which differs in a color and electrical characteristics for every semi-sphere was produced.

[0060] It depends on applying a dip coating method, said each particle is immersed into a water-repellent oil repellent agent (finishing agent) (trade-name Sumi Flon: SAKATA INX make) solution, the water-repellent oil-repellent coat of thickness 0.2 [μm] extent is formed, and 2 [time amount] - 3 [time amount] extent is dried.

[0061] In order that a water-repellent oil-repellent coat may make it hard to separate, 5[part] extent is heat-treated after said desiccation all over the furnace which made temperature 100 [**].

[0062] 2 liquid type silicone rubber KE109 (product made from trade name Shin-etsu chemistry) is made to distribute 2 color revolution particle which performed said water-repellent oil-repellent processing, and 48 [time amount] neglect was carried out and it was made to harden in a room temperature.

[0063] After stiffening silicone rubber, it was checked that 60 [time amount] immersion of this sheet was done into silicone oil (a trade name SH200, 20cS: Dow Corning Toray Silicone make),

and the cavity had been generated.

[0064] The transparent electrode was formed in front flesh-side both sides of the sheet which consists of silicone rubber with the cavity containing 2 color revolution particle which is the above, and was made and produced, and when the electric field impressed to 2 color revolution particle were turned on and off, the engine performance which can realize the display excellent in quality and responsibility was checked.

[0065] [Example 3 of a comparison] In the example 3, when water-repellent oil-repellent processing was omitted, the cavity was ungenerable about no particles.

[Translation done.]

* NOTICES *

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- 3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is an important section cutting explanatory view for explaining an example of the sheet-like display manufactured with the application of the manufacture approach of this invention.

[Drawing 2] It is an important section cutting side elevation for explaining actuation of a sheet-like display.

[Drawing 3] It is an important section cutting side elevation for explaining actuation of a sheet-like display.

[Drawing 4] It is an important section cutting side elevation showing the display medium indicated as an United States patent.

[Drawing 5] It is an important section cutting side elevation for explaining a motion of a revolution particle.

[Description of Notations]

11 Sheet Base Material Which Consists of a Transparent Layer Optically

12 Cavity with which it was Formed in Sheet Base Material, and Translucency Liquid was Filled Up

13A, 13B, and 13C Revolution particle in which the coloring layer was formed

14 Coloring Layer

15 Transparence Common Electrode

16A, 16B, and 16C Display electrode

17 Actuation Circuit

17A Signal input edge

18 Power Source

[Translation done.]

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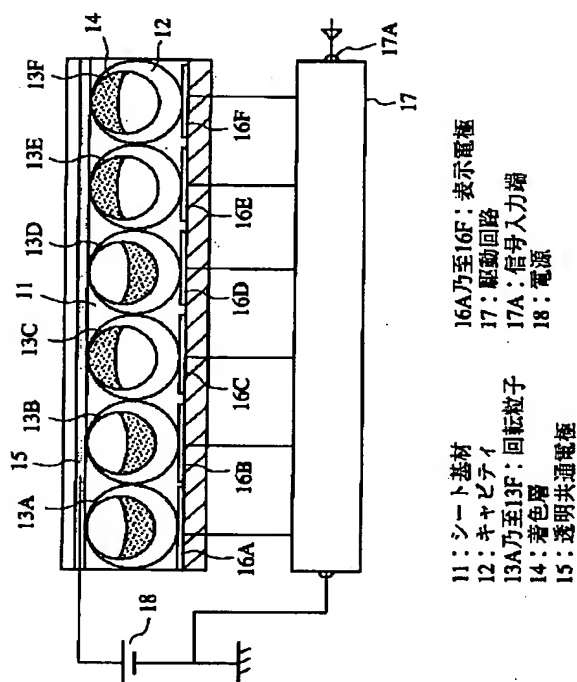
2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DRAWINGS

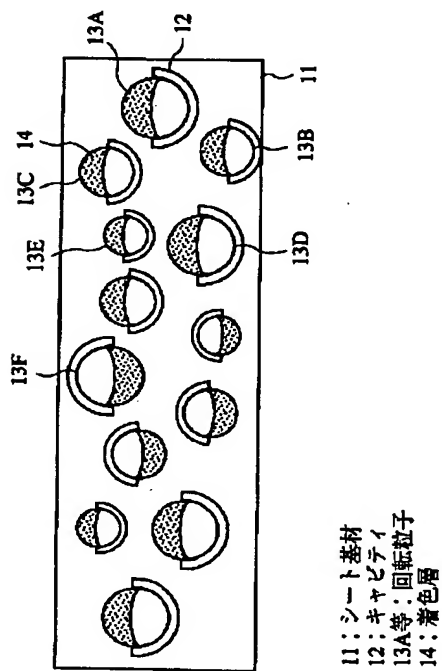
[Drawing 1]

シート状表示装置の要部切断説明図



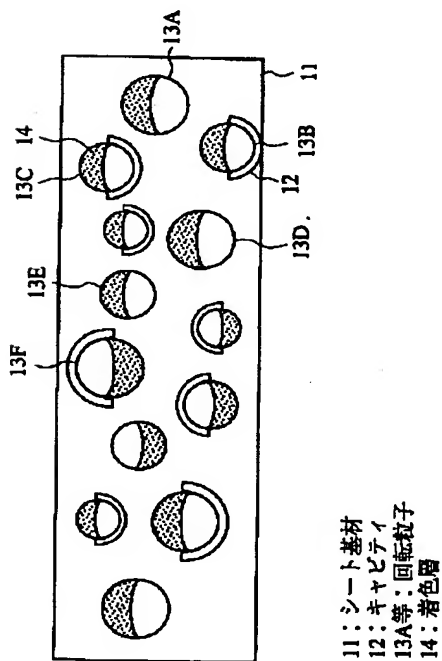
[Drawing 2]

シート状表示装置の要部切断側面図



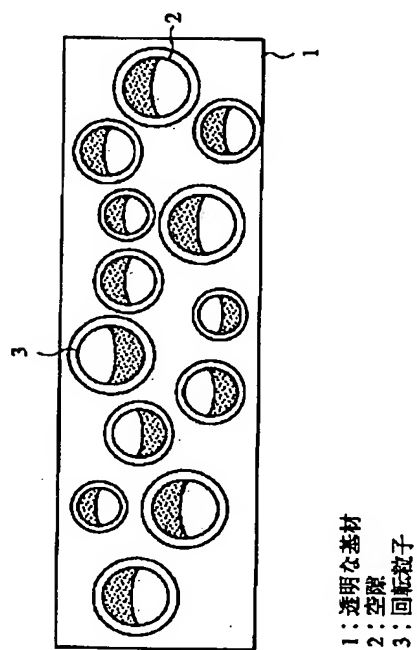
[Drawing 3]

シート状表示装置の要部切断側面図



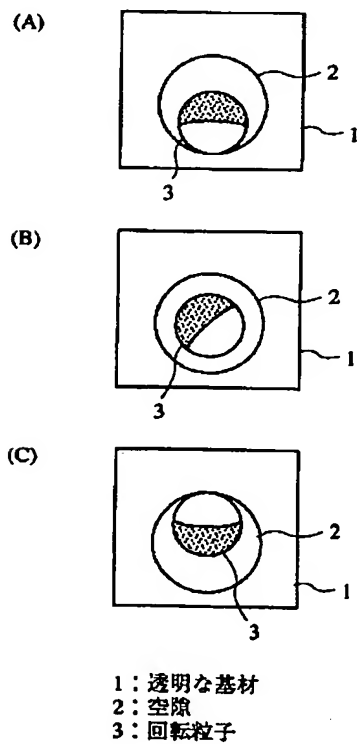
[Drawing 4]

表示媒体の要部切断側面図



[Drawing 5]

回転粒子の動きを説明する為の要部切断側面図



[Translation done.]